PATENT SPECIFICATION

739,495

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CORRECTION OF CLERICAL ERROR

SPECIFICATION NO. 739,495

The following correction is in accordance with the Decision of the Superintending Examiner, acting for the Comptroller-General, dated the thirtyfirst day of January, 1956.

Page 1, line 67, *for* "dependent" *read* "independent".

THE PATENT OFFICE,
7th March, 1956

DB 33057/1(1)/3504 100 3/56 R

tensively in airplane construction. Consequently, they must be as light in weight as is compatible with their requisite strength. For this reason, it has become the practice to "draw" them from ductile sheet material that is, to form them with dies into a blank carrying a thin walled sleeve which is afterward threaded to enable the sleeve to function as a nut body when applied to a threaded rod or bolt.

One of the objects of this invention is to produce a nut of this type that includes a sleeve having a relatively thin light-weight wall, the blank from which the nut is formed being adapted for machining with a high speed cutting tool: and in which the material in the completed nut has characteristics that enable it to present substantially the same or greater resistance to shear stresses along its thread as that of an ordinary solid walled nut of equal depth.

Another object of the invention is to provide a nut of this type which will function as a check-nut, that is to say which will satisfactorily resist forces tending to unscrew it; and which will not become loose when subjected to continuous vibration.

According to the present invention there is provided, a light-weight nut made from ductile sheet material comprising a sleeve having continuous integral threads therein, the central opening within the threads being substantially circular adjacent one end of the sleeve and being substantially elliptical

heat treatment to be deflected toward rounded condition by a mating bolt and to recover fully its initial elliptical shape upon the bolt being withdrawn.

In connection with the problem of vibration effects it should be stated that in the nut forming the subject of the present invention, the check-nut effect is inherent in the characteristics of the threaded nut wall, and is dependent of whether the nut is screwed up with great force upon its seat.

As regards the nut considered as a new article of manufacture, the invention consists in the novel features and combinations of the same, all of which co-operate to produce an effective and serviceable light-weight nut and check-nut.

Further objects of the invention will be apparent from a careful reading of the following specification, and study of the accompanying drawing.

In the accompanying drawing:—

Fig. 1 is a top-plan of a nut blank that may be used, if desired, for practicing the invention:

Fig. 2 is a vertical section through this nut taken about on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 but illustrating the next stage in the method of producing the nut, that is to say, the stage after the blank has had is thread cut in it;

Fig. 4 is a section extending along the thread of the completed nut and illustrating

the appearance of the thread when its proper threaded member, such as a bolt is screwed into the nut, or vice-versa. This view is upon a larger scale;

Fig. 5 is a longitudinal section broken away, through a pair of dies such as I prefer to employ to deform the nut wall when it is desired to transform the nut into a check-nut, and illustrating a threaded nut set between the dies preparatory to its being deformed thereby;

Fig. 6 is a vertical section taken along the broken line 6—6 of Fig. 5 and particularly illustrating the preferred sectional form of the deforming dies when a portion of the wall of the threaded nut sleeve is being deformed into a substantially elliptical outline;

Fig. 7 is a top-plan view of the completed check-nut.

In practising this invention, there is employed a blank from which to form the completed check-nut, which is composed of a material having relatively low resilience and low elastic limit. Such a blank has a transverse flange or disc-form plate disposed substantially at right angles to the axis of the nut and has an integral sleeve with a cylindrical bore co-axial with the transverse flange or head that forms part of the nut.

By reason of the fact that the blank has the composition stated, it is capable of being machined at a high speed for the cut being made, and for this reason facilitates greatly the quantity production of the check-nut.

The wall of the nut blank is of substantially uniform thickness, but in practice if the nut is of metal it would be drawn out from a relatively thin plate of ductile metal including metal that would also form the "flange" or disc-form plate of the nut. The sleeve may taper slightly towards its tip that is remote from the flange or disc of the nut. There is no objection to this and in fact I prefer to have the thickness of the wall toward the tip of the sleeve slightly less than the body portion of the sleeve.

The first step comprises tapping, or cutting a deep V-shape thread groove throughout the entire length of the bore of the sleeve. In the drawing Figs. 1 and 2 illustrate a type of nut blank that may be used, by way of example to illustrate and describe the invention. Fig. 3 illustrates a nut blank after it has been threaded. The groove of this thread is cut relatively deeply into the sleeve wall, which is relatively thin, thereby leaving a relatively thin section of material of the wall beyond the vertices of the groove of the thread.

After threading the blank to give the nut the features illustrated in Fig. 3, the tip portion of the sleeve is subjected to a force which deforms it by displacing a portion of the wall of the sleeve inwardly, thereby throwing that part of the sleeve slightly "out of round."

The next step consists in treating the threaded and deformed nut to raise its elastic limit and its resilience. By reason of this raised elastic limit, when the bolt or a threaded member, receives the nut screwed on to its thread, the deformed portion of the wall of the sleeve becomes displaced outwardly by the threaded side of the bolt without however exceeding the elastic limit of the material.

In practising the invention the wall of the sleeve may be displaced inwardly at a single point or line on the periphery of its wall; or it may be forced inwardly at two diametrically opposite points, or even at a greater number of points equidistant around the periphery of the sleeve.

In the following specification there is described the invention as applied to a blank formed of a metal such as high carbon steel, or stainless steel, or any metal alloy that is capable of treatment after threading the sleeve to raise its elastic limit of the material. However, any temperable material can be used to form the blank which *in the blank* has low resilience and low elastic limit; and if required by specifications the nut could be formed of copper alloyed with beryllium.

Referring more particularly to the parts, Figs. 1 and 2, illustrate a nut-blank having a disc-form face plate or flange 1 the marginal portion of which is disposed at right angles to its plane to form a polygonal wall 2. In the present instance this wall has the form of a hexagon which is its preferable form; and co-axial with the marginal wall 2 the blank includes a sleeve 3 which is of substantially cylindrical form with a cylindrical bore 4 extending through it.

The wall of the sleeve 3 when formed up from a ductile plate is usually substantially uniform in diameter outside, but the drawing operation usually results in the tip portion of the sleeve remote from the flange 1 having a slight taper such as indicated in Fig. 4. As a matter of fact, in practice, with a nut of small size this taper would be measurable in thousandths of an inch.

In practice also it is preferred to have the sleeve 3 of considerably greater length than the length of the hexagonal wall 2 of the blank. This is to insure that there will be sufficient length in the body portion of the threaded sleeve to give the nut sufficient area of cross-section to resist any shear stresses that would normally be developed by a thrust force or a tensile force acting longitudinally through the bolt to which the nut is applied.

The blank, such as illustrated in Figs. 1 and 2, is placed in a tapping-machine, and a continuous thread 5 (Fig. 3) is cut or tapped in its bore 4; and this thread is of V-form in section, (see Fig. 4) wherein the depth of the

thread is indicated at *a* between the lines *c* and *d* which are respectively in line with the inner and outer vertices of the threads. In practice, the depth of the groove cut should be such as to substantially cut away a considerable part of the thickness of the wall of the sleeve.

Referring now to Figs. 5 and 6, after the threading operation, the unfinished nut 6 is placed between two dies 7 and 8 mounted between two side walls 9 of a press 10. While both of these dies could be moved to deform the tip portion of the nut 6, in Fig. 5 is illustrated the lower die 8 as fixed, by being bolted to the bottom 11 of the press. The upper die is movable about a transverse bolt or shaft 12 at the rear of the press. The forward ends of the dies 7 and 8 have tapered noses 13 and present inclined upper and lower faces 14 that conform to the 60 degree internal angle at the corners of the hexogonal apron 2 of the nut. That is to say, the upper and lower faces have this form, but the inner face of each die is finished to a radius 15 that is slightly greater than the radius of the outer wall of the sleeve 3. Fig. 6 illustrates this, and shows the side faces of the two dies seated against vertical faces 16 of the press between which the dies are mounted. In practice the difference in these two radii would be very slight and in small nuts would be of the order of thousandths of an inch. In Fig. 6 the relation of these arcs or curves is exaggerated in order to make the same apparent.

The cylindrical faces 15 extend a considerable distance back towards the rear of the dies so as to provide a place for a coiled spring 17 the ends of which are received in sockets 18 drilled up, or down, into the concave curved faces 15. This spring exerts its force to hold the upper face 19 of the upper die normally against a stop, or against the plunger 20 of the press which is controlled by its operator.

The extreme tips of the tapered noses 13 project slightly forward past the vertical forward face 21 of the press; this is to assist the operator in positioning the nut-blank in the press.

In using the press the operator sets the nut in place with the sleeve projecting into the space between the two noses 13, and the inner end of the hexagonal wall seated against the press. Then he orients the nut so that the hexagonal wall 2 is disposed in the manner indicated in dotted lines in Fig. 6; in other words, two side walls of the nut hexagon are parallel with the side faces 16 of the space in which the dies are located.

On account of the fact that the radius 15 is greater than the radius of the outer face of the sleeve wall, after the plunger 20 has operated to depress the movable jaw 7, the upper and lower portions of the sleeve wall as shown in Fig. 5 and 6 will have approached each other, that is, they will have been deformed so as to displace them inwardly towards the axis of the nut, and the sleeve at the portion adjacent the noses of the die will assume an oval or more or less elliptical cross-section.

After deforming the tip portion of the sleeve in this way, the nut will have substantially the characteristics illustrated in Fig. 7, in bottom plan. This incomplete nut, in the case of a metal nut is then heat-treated to raise its elastic limit and resilience. This treatment, of course, hardens the material of the nut. In practice, the preferable heat-treatment should give the sleeve a hardness of 45 to 50 Rockwell on the scale. This is practicable when using a high carbon steel known as No. 1070 (Plain Carbon). A suitable stainless steel may be also employed as the composition of the nut blank.

The portion of the sleeve 3 remote from the flange 1 is of substantially elliptical shape so that, as shown in Fig. 7, the major diameter of the central opening at the extreme end of the sleeve is greater than the diameter of the circular opening within the flange 1, and so that the minor diameter of the central opening at the extreme end of the sleeve is less than the diameter of said circular opening. The surface defined by the pitch line of the threads has the same shape as the central opening; it is circular at one end and elliptical at the other. The sleeve has no abrupt discontinuities nor sharp demarcations, but on the contrary the form of the sleeve changes gradually and merges from the circular section to the maximum out-of-round section. In any one plane normal to the axis, the wall thickness of the sleeve excluding the threads is constant.

Referring again to Fig. 4, the bolt 27 is illustrated with its threads in engagement with the thread 5 of the completed nut. This bolt would be introduced into the threaded bore from below and when the tip of the bolt arrives at the incline or slope 28 near the tip portion of the sleeve, the advancing bolt thread passing into the grooves at this point forces the sloping wall at 28 outwardly so as to bring it back to make it conform substantially to its original circular form; and due to the fact that this restoring movement occasioned by the bolt is not sufficient to overcome the raised elastic limit of the material, it follows that at the tip portion of the sleeve the sleeve wall presses itself forcibly against the threads of the bolt. This gives a check-nut effect.

It is believed that the constricting action of the tip portion of the sleeve is enhanced by the fact that there is a small section of the metal wall between the outer vertical of the V-grooves and the outer face of the wall of the sleeve. For example, as measured on

the horizontal line 29 in Fig. 4. In connection with this line 29 one can consider that it can be thought of as one line on a helical zone of lines extending continuously around the wall of the sleeve throughout the entire slope of the inclined deformed part of the sleeve. This narrow helical zone passes through resilient metal that permits any necessary movement of the grooves in the sleeve to enable them to adapt themselves to hug the thread of the bolt—and without any possibility of the material being stressed beyond its raised elastic limit. This prevents the nut from cracking along this helical zone of lines.

On account of the fact that the operating faces of the dies incline somewhat to the axis of the sleeve, the deformation of the sleeve is gradual in an outward direction toward the tip of the sleeve where it has its maximum. This gradual change in section is most desirable. It will also be evident that the section of the nut under shear stresses at the locus of the thread is far superior to that of a nut having a low elastic limit for the reason that the sleeve is capable of stretching along its own longitudinal axis. This ensures that all of the turns of the thread do their part in resisting thrust forces or tensile forces acting through the bolt.

Many other embodiments of the invention may be resorted to without departing from the scope of the invention.

What I claim is:—

1. A light-weight nut made from ductile sheet material comprising a sleeve having continuous integral threads therein, the central opening within the threads being substantially circular adjacent one end of the sleeve and being substantially elliptical adjacent the other end of the sleeve, a member formed integrally with the sleeve at the circular end thereof and being capable of transmitting torque, the wall thickness of the sleeve being of substantially uniform thickness, the sleeve form gradually changing and smoothly merging axially between its ends without sharp discontinuities nor abrupt cross-sectional variations the nut being heat-treated after completion of all forming operations, the elliptical portion of the sleeve being sufficiently thin and elastic after such heat-treatment to be deflected toward re-rounded condition by a mating bolt and to recover fully its initial elliptical shape upon the bolt being withdrawn.

2. A light-weight nut substantially as shown and described with reference to the accompanying drawing.

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FIG. 1.

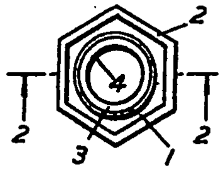

FIG. 2.

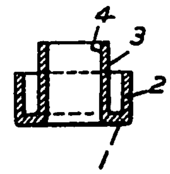

FIG. 3.

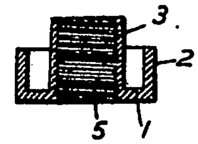

FIG. 4.

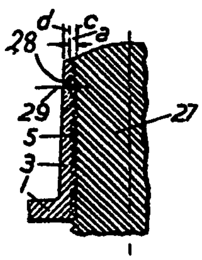

FIG. 5.

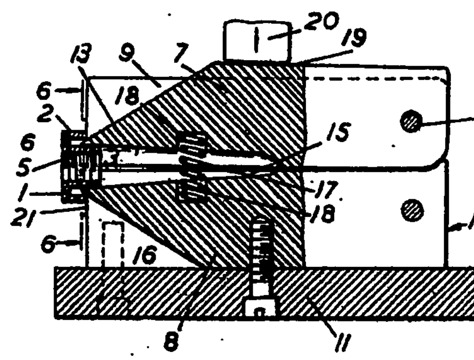

FIG. 6.

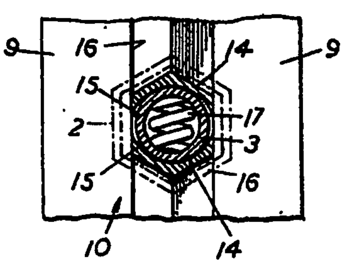

FIG. 7.